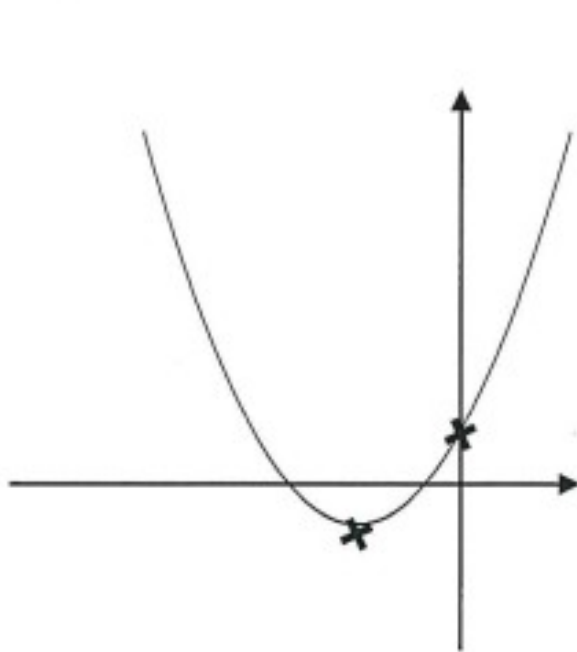
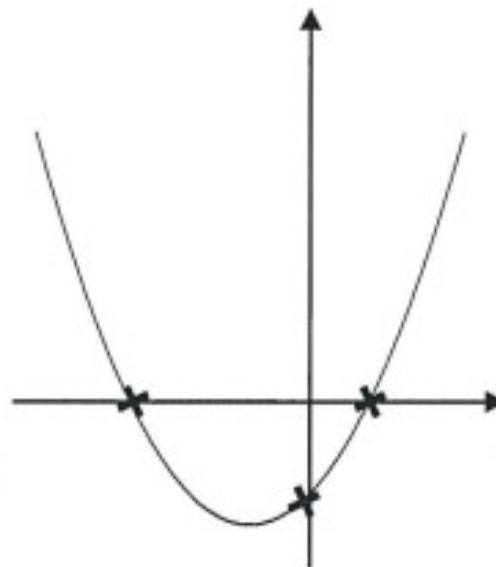


# 1.5 Simultaneous Equations – Starter

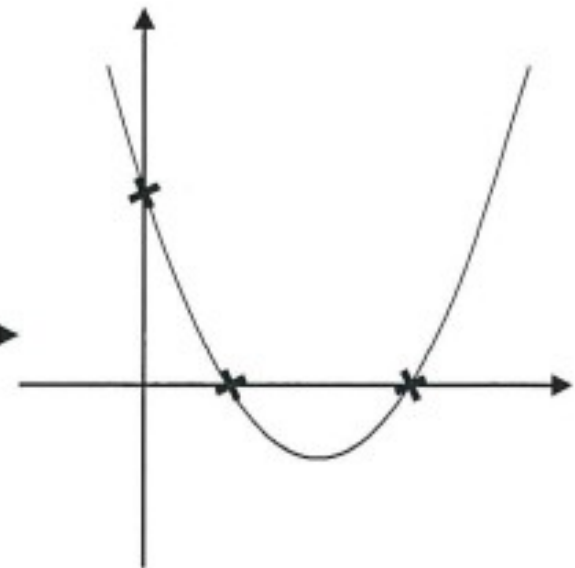
CAN YOU FIND THE COORDINATES MARKED?



$$y = (x + 2)^2 - 3$$



$$y = x^2 + 3x - 4$$



$$y = (2x - 1)(x - 3)$$

# 1.5 Simultaneous Equations – Starter

**Any questions on yesterday's  
exercise?**

$$x^2 - 4ax + 2b + 1 = 0.$$

The above quadratic equation, where  $a$  and  $b$  are constants, has no real solutions.

Show clearly that

$$b > \frac{1}{2}(2a+1)(2a-1).$$

# 1.5 Simultaneous Equations

B4

Solve simultaneous equations in two variables by elimination and by substitution, including one linear and one quadratic equation.

Students should be able to:

- understand the relationship between the algebraic solution of simultaneous equations and the points of intersection of the corresponding graphs
- in the case of one linear and one quadratic equation, recognise the geometrical significance of the discriminant of the resulting quadratic
- solve a pair of linear simultaneous equations using a calculator.

Notes

- Simultaneous equations could arise from problems set on a variety of topics including mechanics and statistics.
- In situations where simultaneous linear equations have to be solved to give numerical solutions, we expect students to do so with a calculator. No working is required. However, there could still be situations where coefficients are given as exact values, or as parameters, when algebraic methods will need to be used.

# 1.5 Simultaneous Equations

## Example 1

Solve  
and

Three methods:  
1.By elimination  
2.By substitution  
3.Using the calculator!

### ***fx-991 ex***

- *Menu A*
- *Simultaneous Equations*
- *2 unknowns*

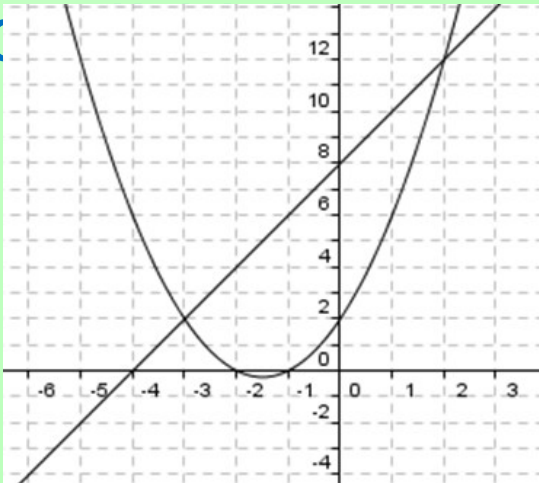
### ***fx-991 cw***

- *Menu*
- *Equations*
- *Simultaneous Equations*
- *2 unknowns*

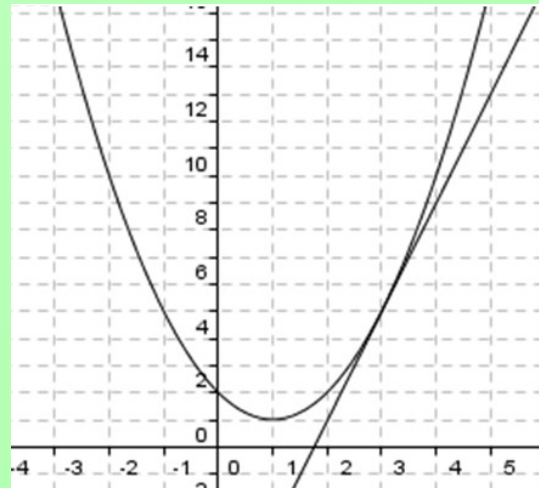
# 1.5 Simultaneous Equations

Solving simultaneous equations where one is linear and the other is quadratic has three

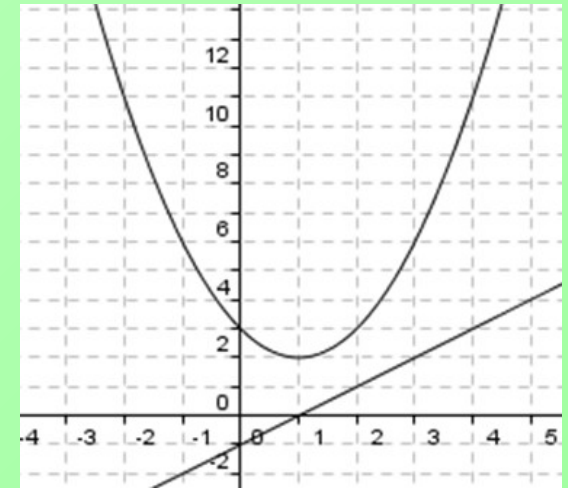
po



**Two distinct  
intersections  
intersections**



**One intersection**



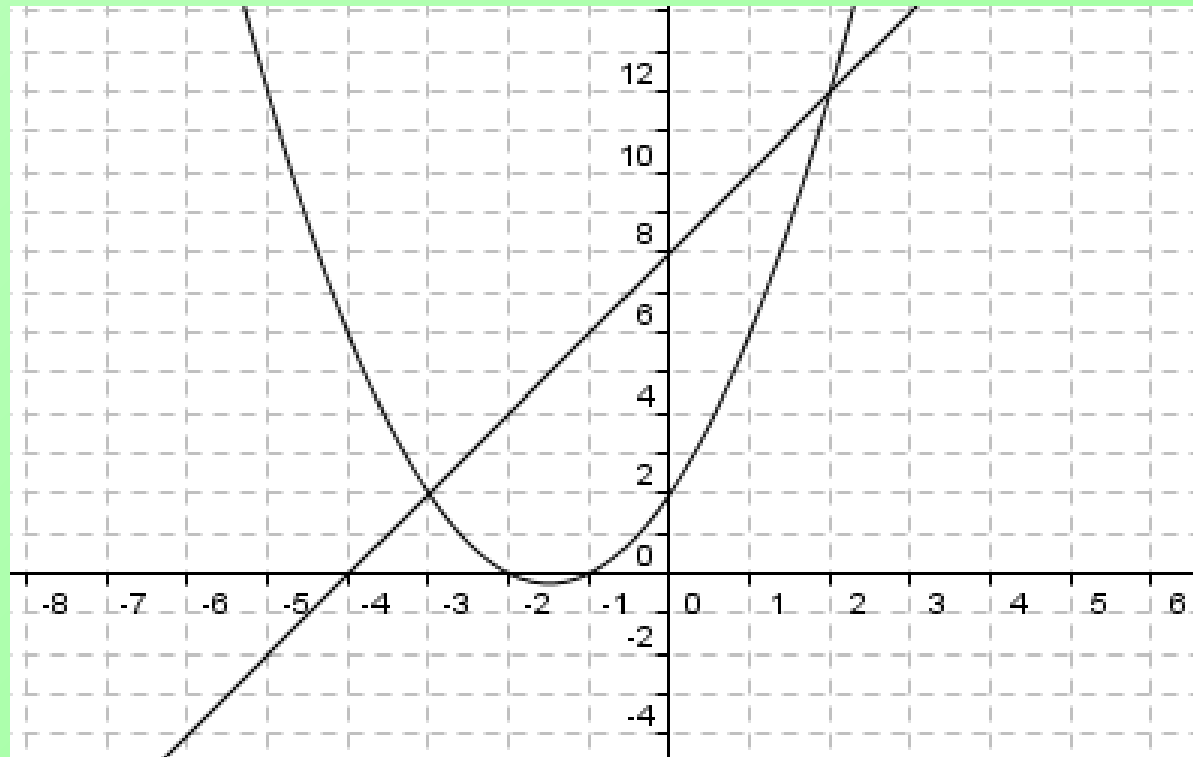
**No**

If we equate the expressions for the curve and the line to find the POI, we will obtain a quadratic.

# 1.5 Simultaneous Equations

## Example 2

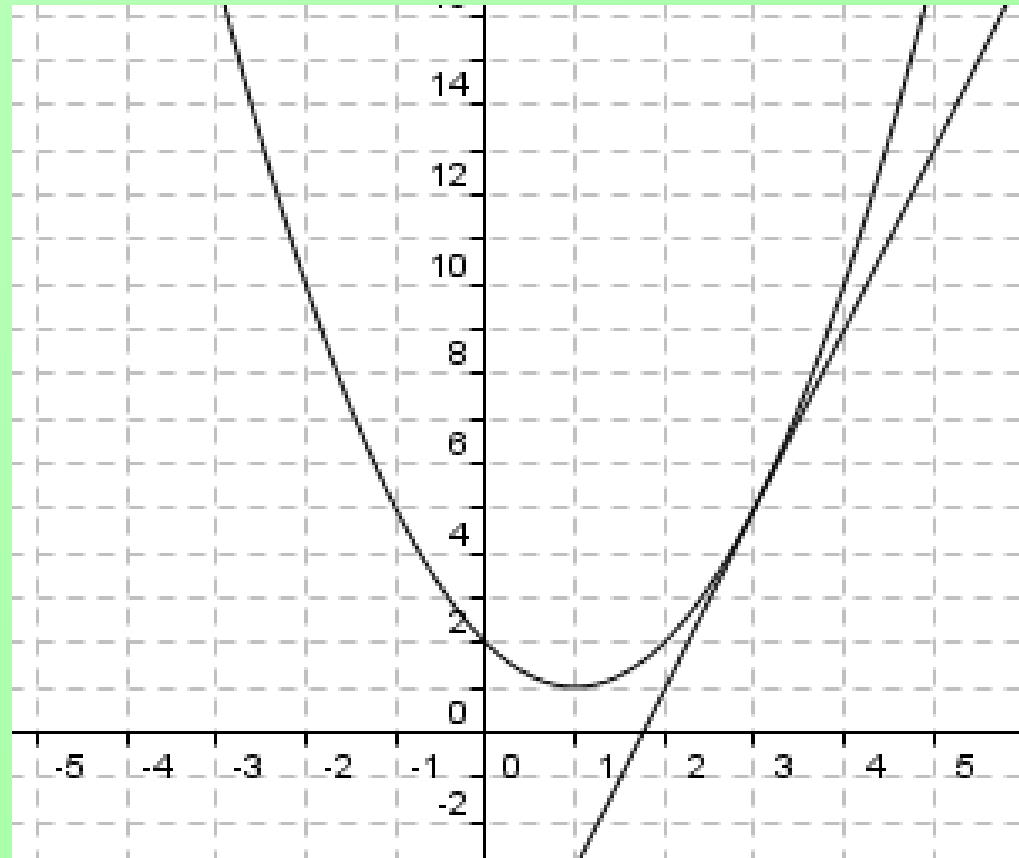
How many solutions are there to these simultaneous equations?



# 1.5 Simultaneous Equations

## Example 3

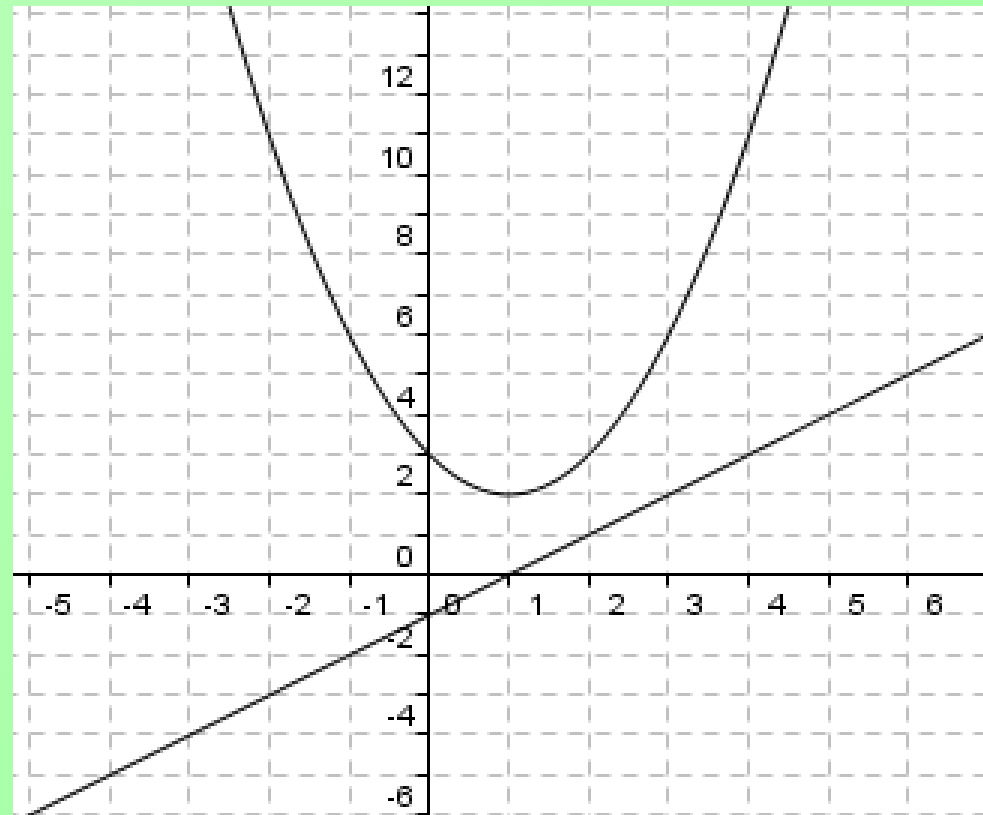
Show that  $y = x + 2$  is a tangent to the curve



# 1.5 Simultaneous Equations

## Example 4

Show that the line does not intersect the curve





# 1.5 Simultaneous Equations

## Example 5

In this question you must show detailed reasoning.

Determine for what values of  $k$  the graphs  $y = 2x^2 - kx$  and  $y = x^2 - k$  intersect.

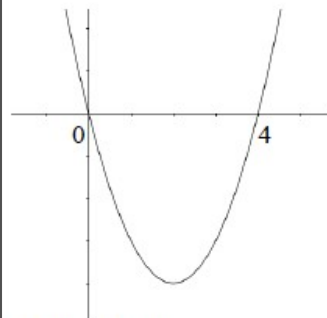
11

$$2x^2 - kx = x^2 - k$$

$$x^2 - kx + k = 0$$

$$\text{discriminant} = k^2 - 4k$$

$$k^2 - 4k \geq 0$$



$$k \leq 0 \text{ or } k \geq 4$$

B1

3.1a

Equating the two expressions must be seen

M1

2.1

Condone one error in rearranging

B1

1.2

M1

1.1

M1

2.4

Or give table of values, oe

A1

2.5

or  $\{k : k \leq 0\} \cup \{k : k \geq 4\}$

[6]

# 1.5 Simultaneous Equations

# Worksheet Qs

## Exam Question

The straight line with equation  $y = 3x - 7$  does not cross or touch the curve with equation  $y = 2px^2 - 6px + 4p$ , where  $p$  is a constant.

(a) Show that  $4p^2 - 20p + 9 < 0$ .

(4)

(b) Hence find the set of possible values of  $p$ .

(4)

(Total 8 marks)

<p>11(a)</p>	$2px^2 - 6px + 4p = 3x - 7$ <p>or</p> $y = 2p\left(\frac{y+7}{3}\right)^2 - 6p\left(\frac{y+7}{3}\right) + 4p$ <p><b>Examples</b></p> $2px^2 - 6px + 4p - 3x + 7 = 0, \quad -2px^2 + 6px - 4p + 3x - 7 = 0$ $2p\left(\frac{y+7}{3}\right)^2 - 6p\left(\frac{y+7}{3}\right) + 4p - y = 0, \quad 2py^2 + (10p-9)y + 8p = 0$ $y = 2px^2 - 6px + 4p - 3x + 7$ <p>E.g. <math>b^2 - 4ac = (-6p-3)^2 - 4(2p)(4p+7)</math>, <math>b^2 - 4ac = (10p-9)^2 - 4(2p)(8p)</math></p> $4p^2 - 20p + 9 < 0 *$	<p>M1</p> <p>dM1</p> <p>ddM1</p> <p>A1*</p> <p><b>(4)</b></p>
<p>11(b)</p>	$(2p-9)(2p-1)=0 \Rightarrow p=\dots \text{ to obtain } p =$ $p = \frac{9}{2}, \quad \frac{1}{2}$ $\frac{1}{2} < p < 4\frac{1}{2}$	<p>M1</p> <p>A1</p> <p>M1 A1</p> <p><b>(4)</b></p>
		<p><b>(8 marks)</b></p>